

Office of Naval Research

S&T - THE NEXT THIRTY YEARS



A Brief given at

Woods Hole Oceanographic Institution

by

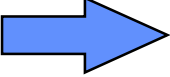
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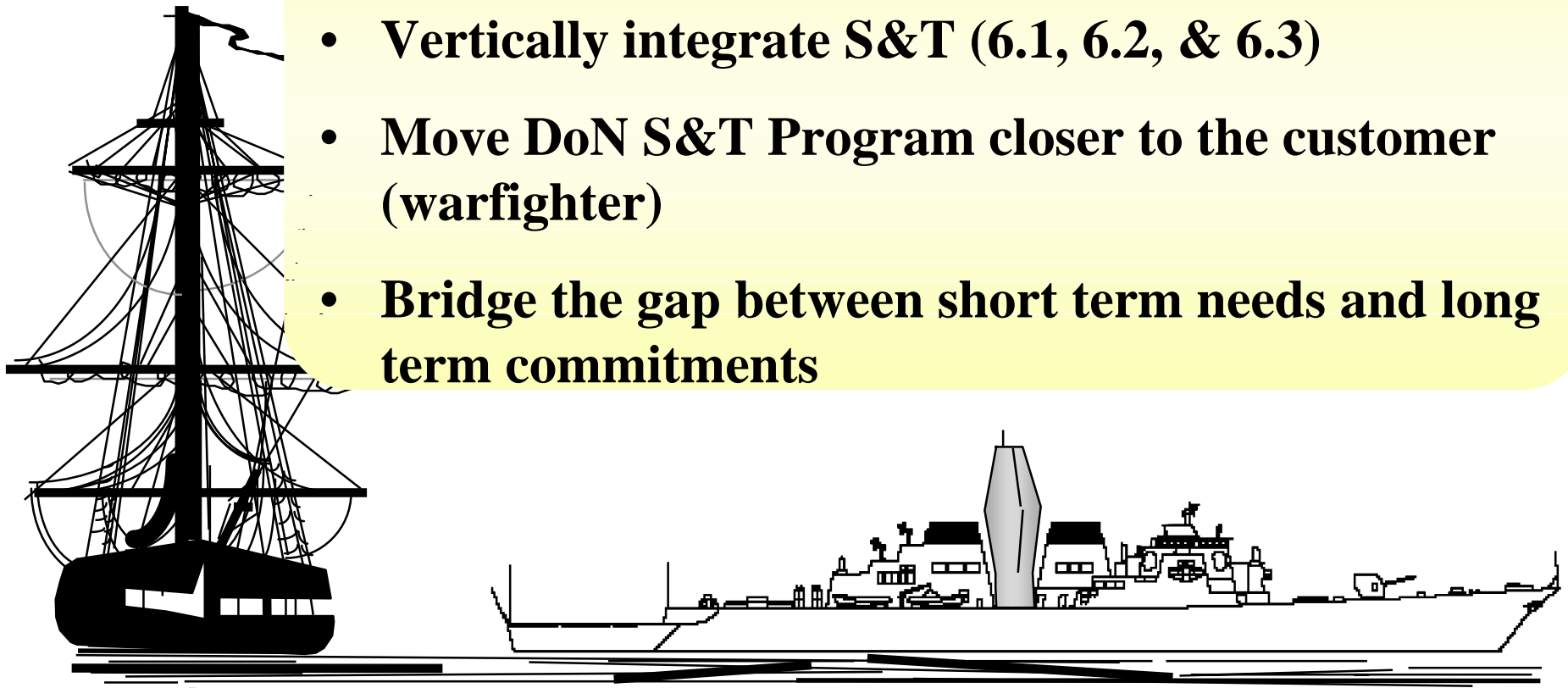
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Outline

- 
- DoN S&T Vision
 - DoN S&T Strategy
 - DoN S&T Investment
 - Summary

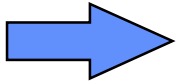
DoN S&T Vision

- **Retain the historic connection to high quality world-class foundation research**
- **Vertically integrate S&T (6.1, 6.2, & 6.3)**
- **Move DoN S&T Program closer to the customer (warfighter)**
- **Bridge the gap between short term needs and long term commitments**



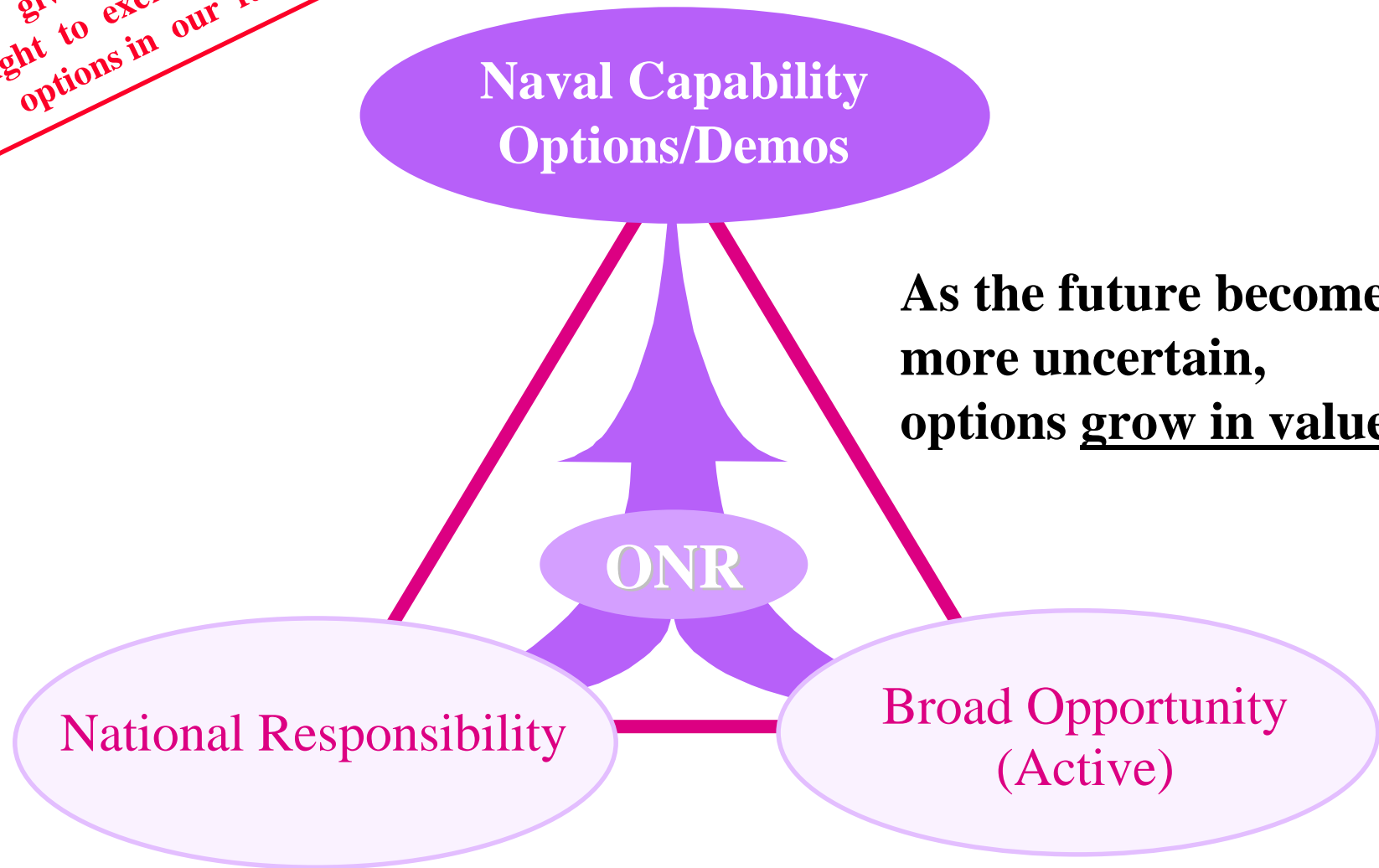
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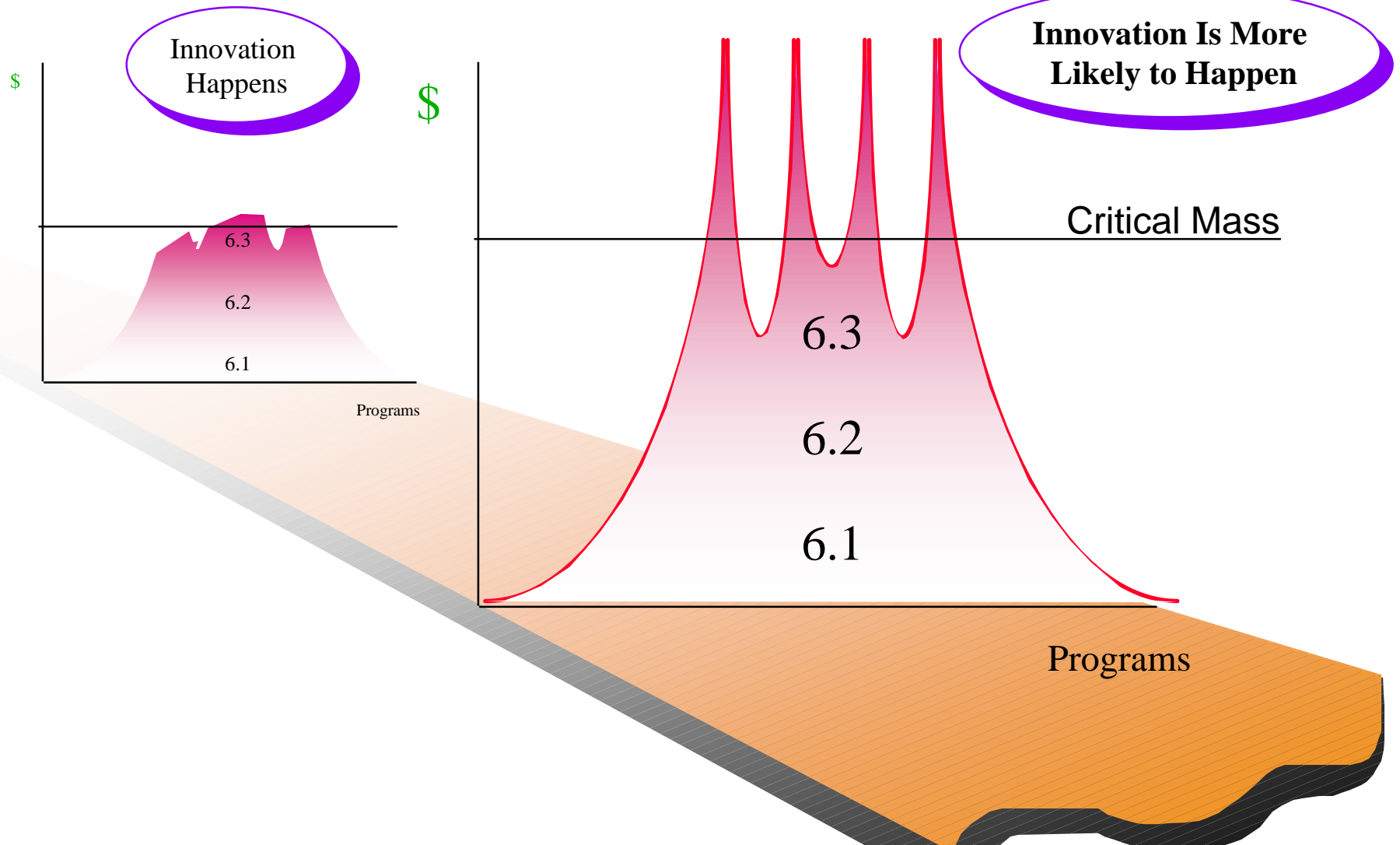
Naval S&T Investment Balance

Naval S&T
giving DON the
right to exercise and test
options in our future

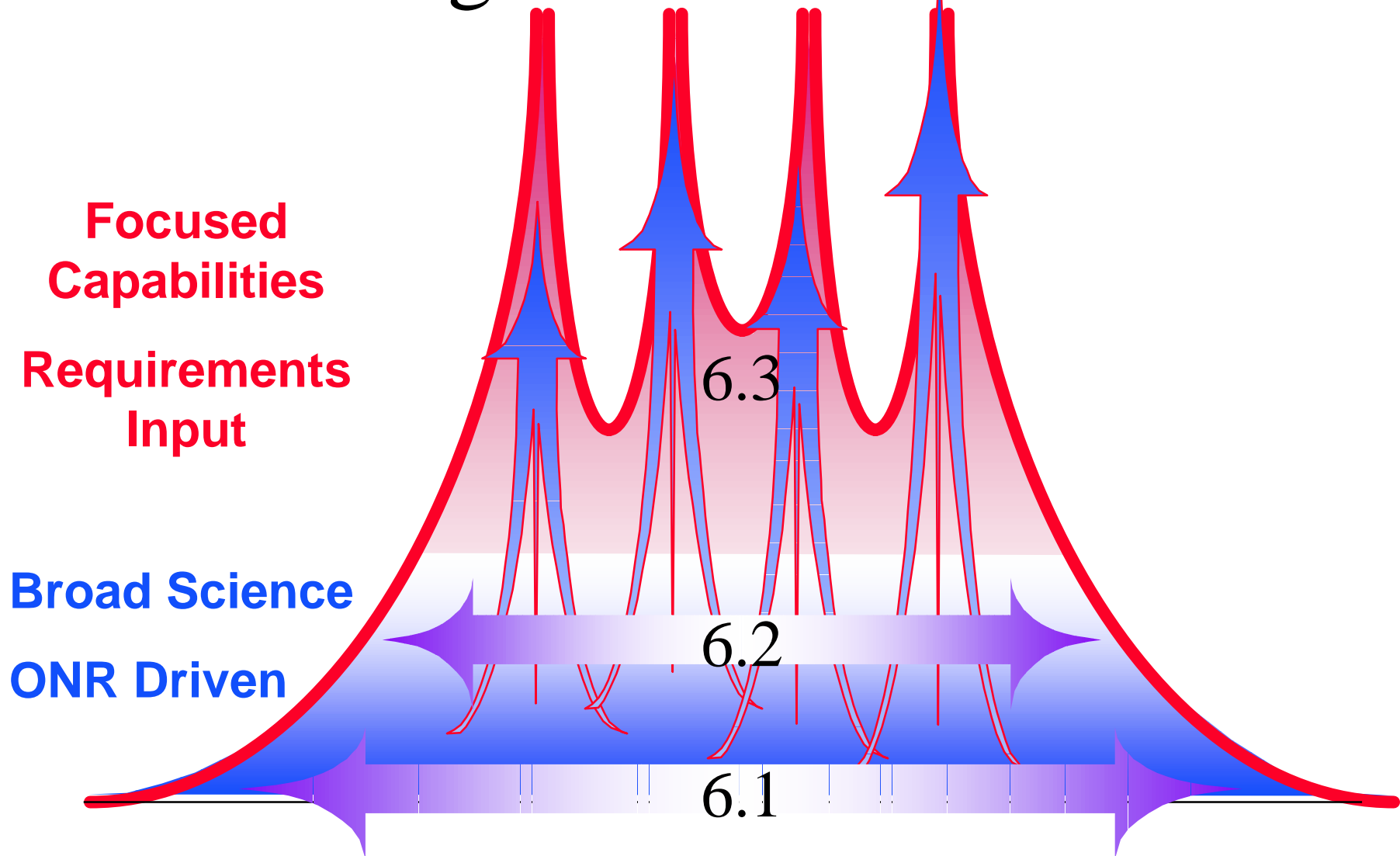


**As the future becomes
more uncertain,
options grow in value**

Forming Critical Mass for S&T



Regimes of Influence



Future Naval Capability Options

Real Time Re-targeting

Advanced Multifunction RF System

Wide Area Surveillance

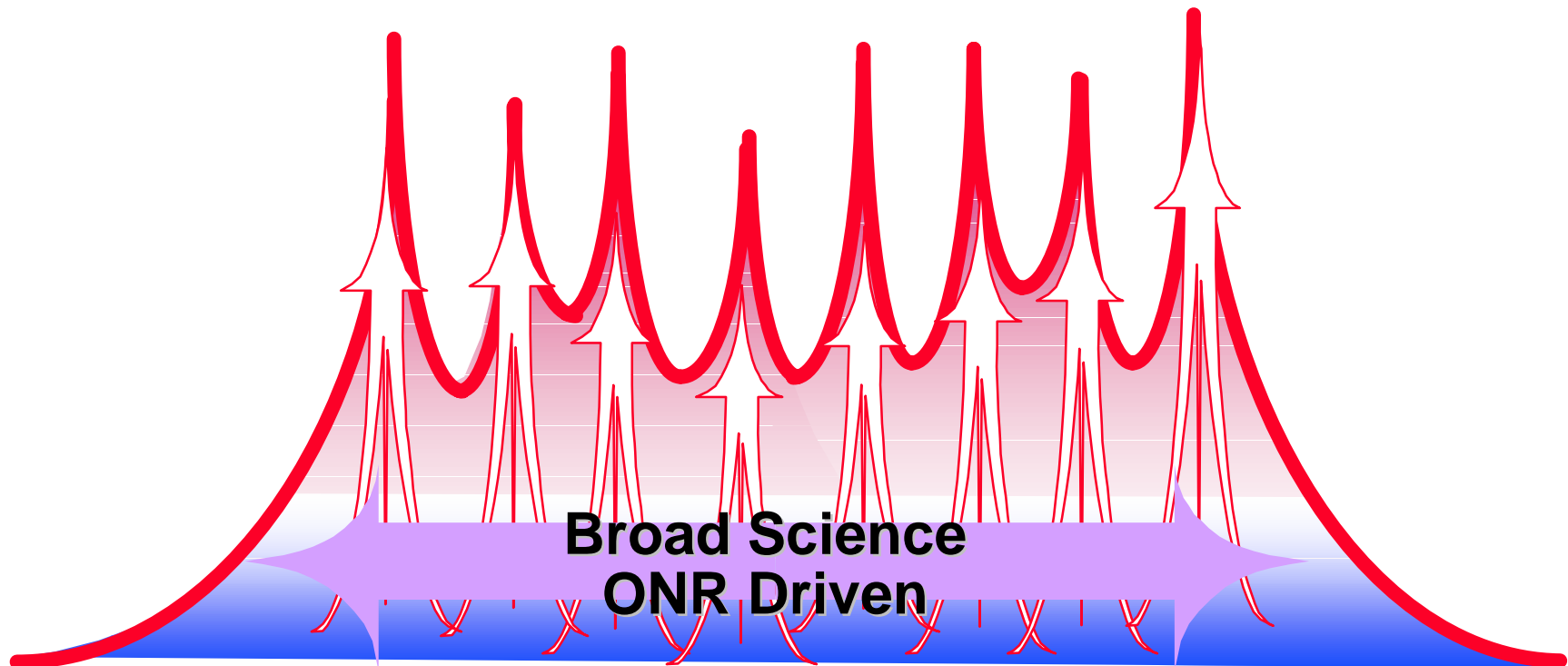
Power Electronic Building Blocks

Mine Countermeasures

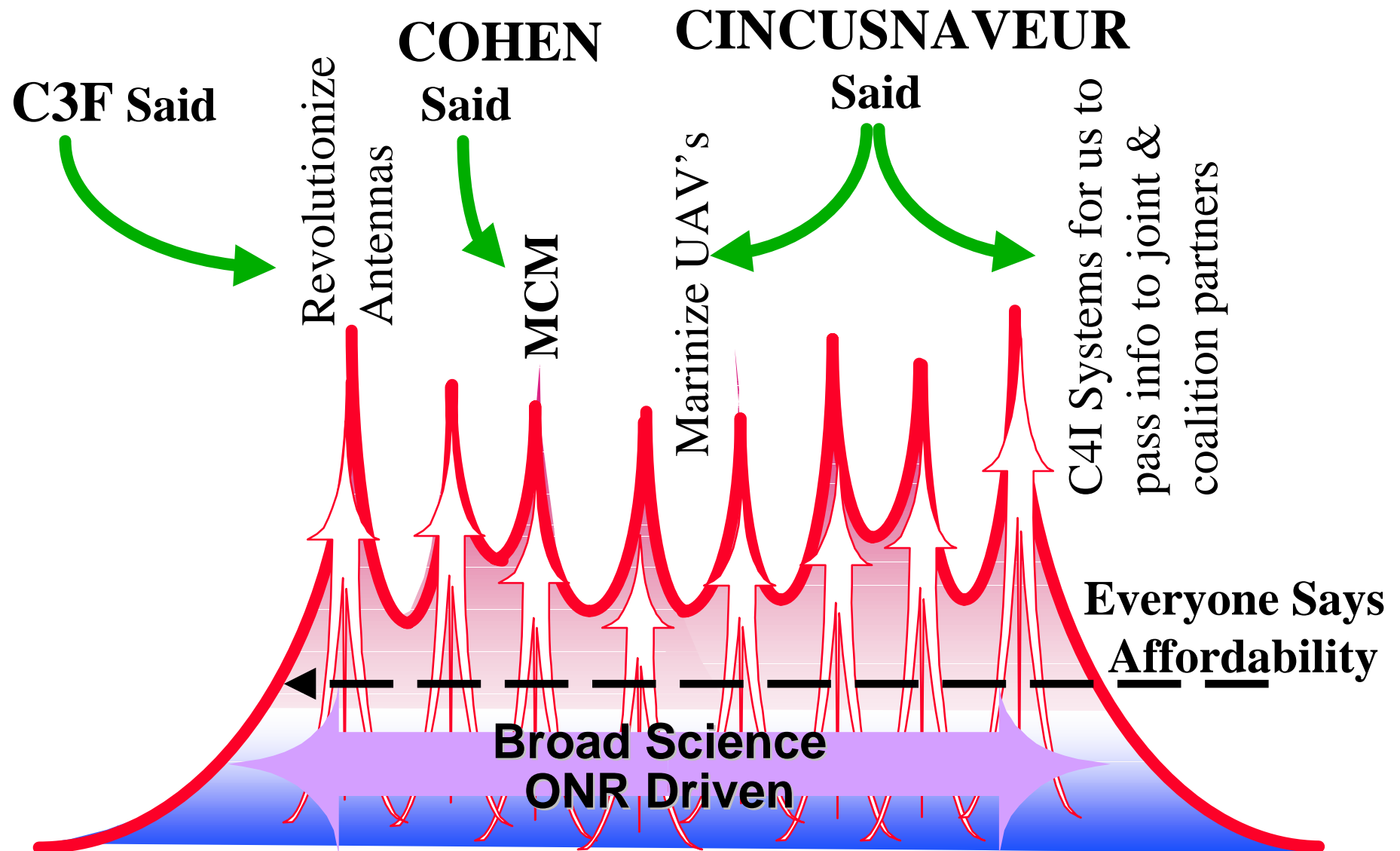
Condition-Based Maintenance

Common Tactical Picture ACI

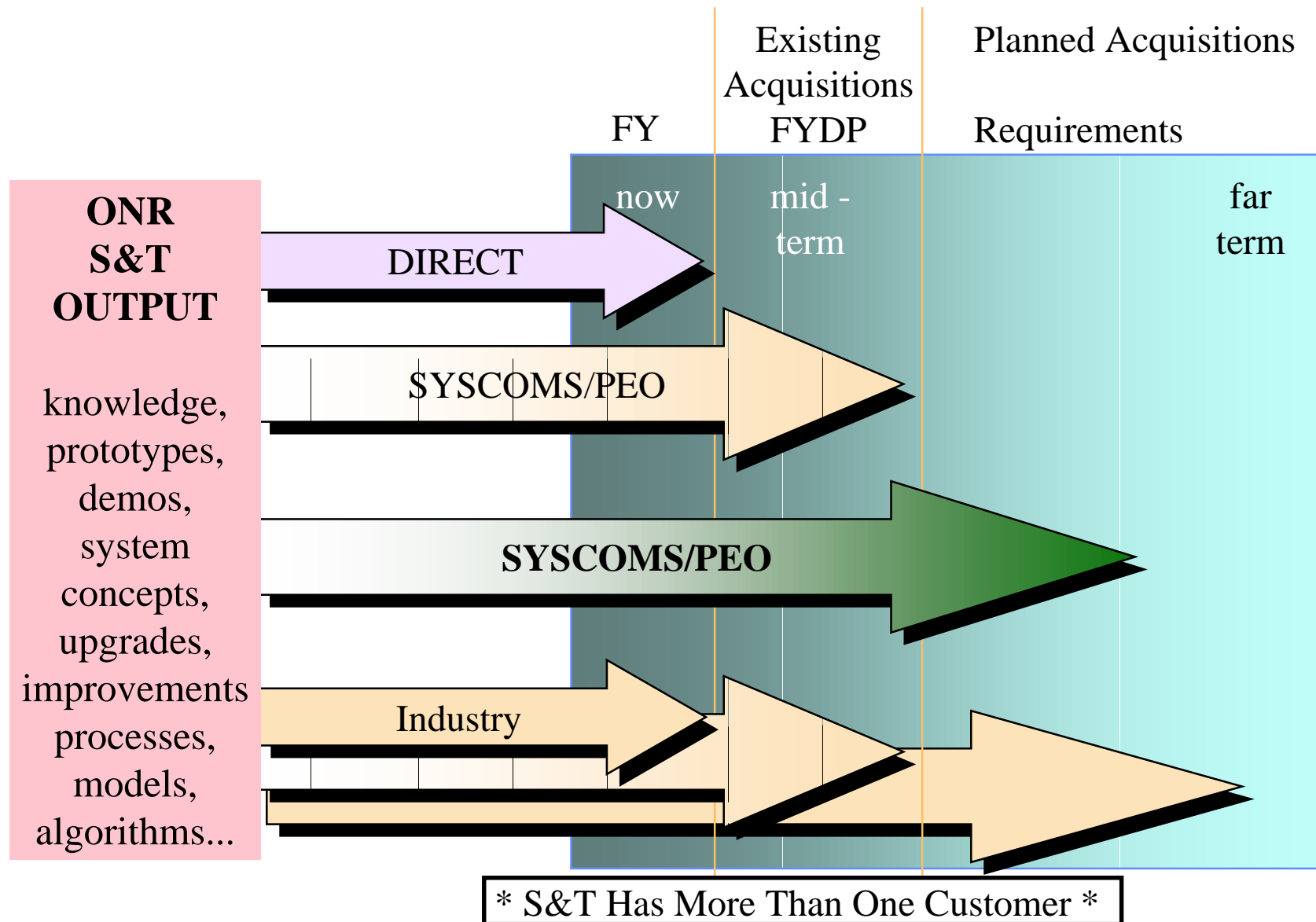
Damage Control



Future Naval Capability Options

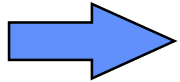


Time Sensitive Technology Capability Options



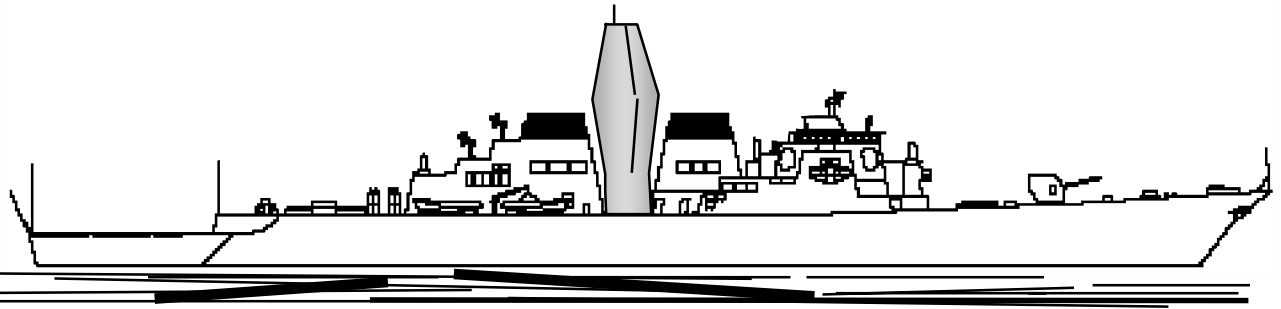
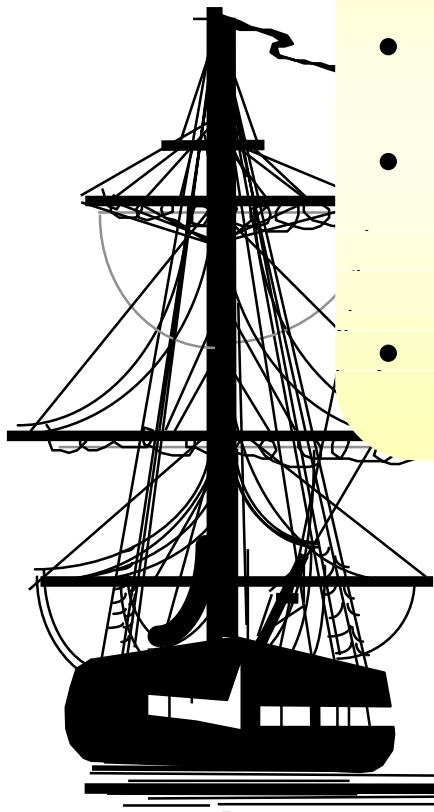
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DoN S&T Vision

- **Retain the historic connection to high quality world-class foundation research**
- **Vertically integrate S&T (6.1, 6.2, & 6.3)**
- **Move DoN S&T Program closer to the customer (warfighter)**
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To Achieve This Vision,

ONR Focuses Environmental Investmeny on:

- Understanding ocean, atmosphere & air-sea processes
- Learn how to simulate & predict those processes
- Be able to determine affect of processes on operations, people, sensors & our big machines
- Rapid characterization & adaptionthat is good enough

STEP ONE

1998-2012 The First Fifteen Years

Big “O” Environments Focus Area

What are we responding to?

- **“Pull”** (DON needs and problems)
 - Air/Ocean/Ice On-Scene Prediction models (especially littoral, usable for training and simulation)
 - Small-scale understanding/characterization supporting MIW/MCM, ExpWar, NSW
 - Deployable, real-time *in situ* sensors, fused with remote-sensing data
 - Knowledge of space/time variability of ocean bottom topography and beach areas
- **“Push”** (S&T opportunities)
 - Autonomous and networked systems
 - AEGIS Tactical weather radar
 - Hyperspectral Sensing
 - Coastal and Open Ocean Observational Techniques
 - Regional Scale Coastal and Open Ocean Prediction Systems
 - Environmentally adaptive capabilities for naval systems/sensors

Big “O” Environments Focus Area

How are we responding?

- **Strategy elements**
 - The littoral region, as the expected battlespace of future operations, will continue to receive emphasis
 - relocatable ocean/atmosphere models, on-scene observations, and on-board prediction ability
 - Increased focus on small-scale processes and related applications because of their prominent role in MCM, AmW, NSW in littoral operations
 - involves environmental issues in optics, acoustics, electromagnetics, hydrodynamics, biology/chemistry, geology/geo technology
 - BSE will be a leader in bringing the national resources to bear on the most pressing issues in Naval oceanography
 - maintain strong support of the academic community
 - NOPP is mechanism for increased interagency discussion and cooperation
 - Continue to develop stronger ties to BSE major customer (N096)

Big “O” Environments Focus Area

How are we responding?

- **Thrusts/Technical Challenges**

- Predictive Systems

- develop ocean and atmospheric observations and models that provide predictive ability to the on-scene commander, with special emphasis on the littoral zone
 - develop advanced wave prediction methods and radiative transfer models for visibility in the ocean and atmosphere

- Large Scale Processes

- develop understanding/characterization of the large scale processes in the ocean and atmosphere that control the overall setting in which most naval operations occur

- Small Scale Processes

- develop understanding/characterization of small scale processes that affect systems (acoustic, optical, electromagnetic/electro-optic, gravity and magnetic)
 - coastal hydrodynamic processes and fluid/structure interactions

- Sensors/Data

- atmospheric and oceanic observations at high resolution in denied areas

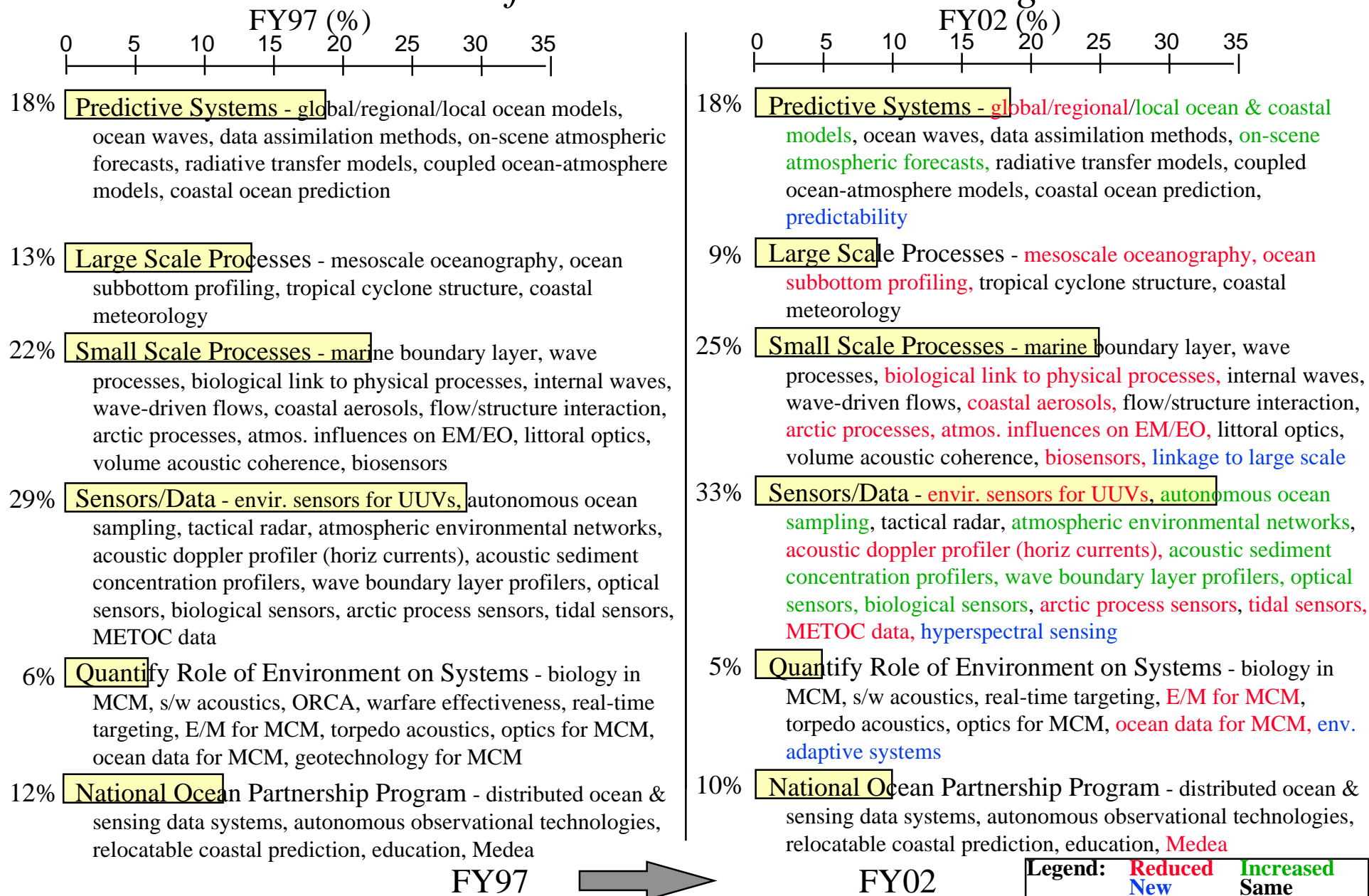
- Quantify Role of Environment on Systems (jointly)

- determine for all warfare areas the most critical environmental data
 - quantify impact of environmental data in all warfare areas

- National Ocean Partnership Program

Big “O” Environments Focus Area

Evolution of Thrusts/Technical Challenges



STEP TWO

2013-2028: The Following Fifteen Years

The Next Thirty Years

(The Second Step 2013-2028)

THE ENVIRONMENT

- No-One Knows if Global Politics Calls for:
 - 1 or 2 Medium Scale Regional Conflicts
 - Large Scale Conflict
 - Few to Many Humanitarian or Peacekeeping Actions
 - Or Some Combination of the Above
- The Fleet and Marine Corps Must be Agile
 - Capable to Carry Out Whatever Mission Arises

The Second Step

2013-2028

FLEET STRUCTURE

- Beginning of the “Navy after Next”
- DD 963, AEGIS Gone - or Very Aged
- More than Half of Nimitz Class CVN Retired
- Burke Class and LHX at Mid-life
- NSSN, DD 21 Construction Complete
- CVX Improvements Underway
- F/A 18E/F, V22, Common Support Aircraft
- AAV

Grand Challenges

Why “Grand Challenges?”

- a strategy to provide long-term focus

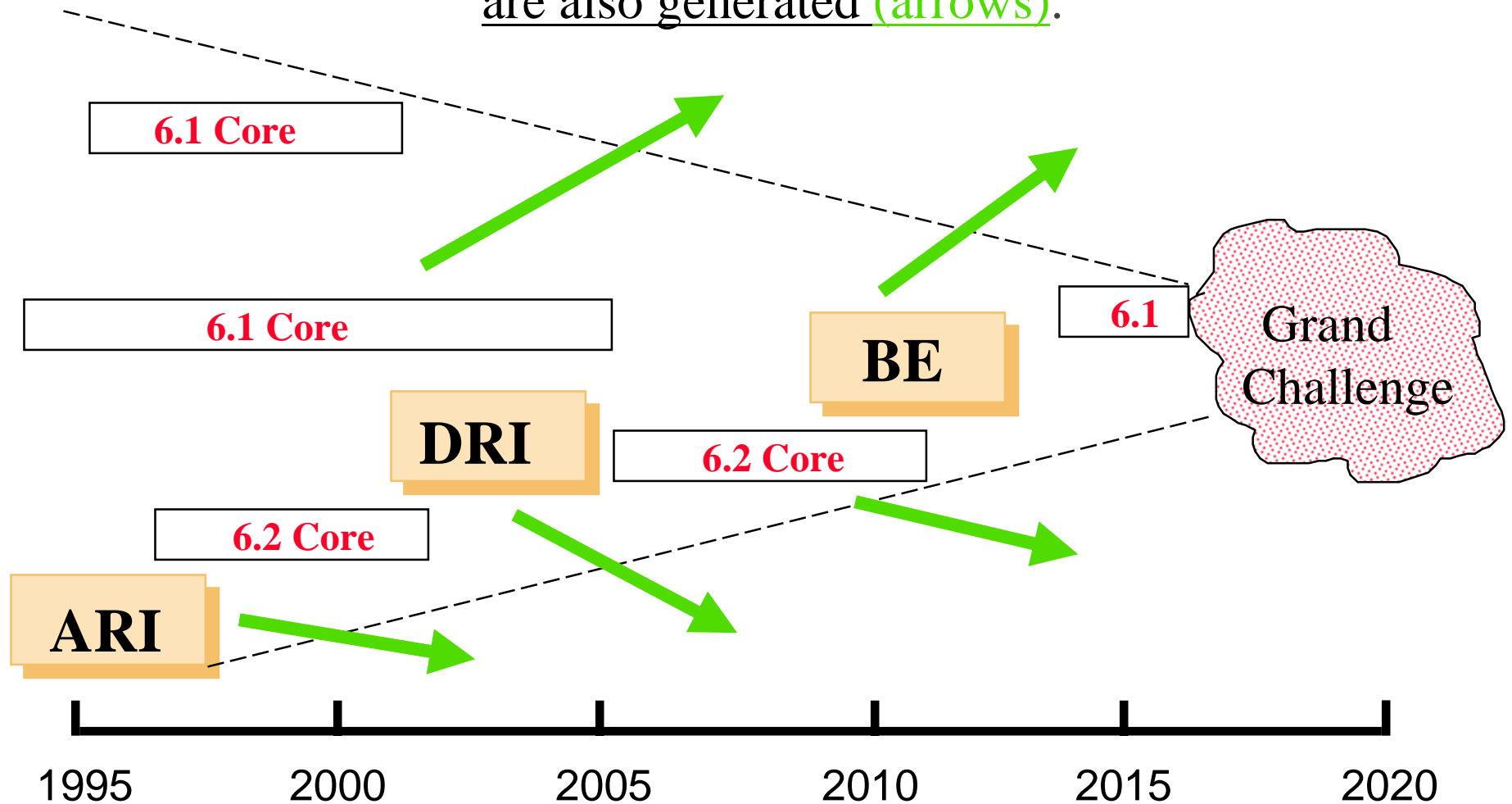
What are “Grand Challenges”

- a steady, achievable view of the future
- high-level objectives that have some risk, some excitement, some motivational value

Key Characteristics

- unambiguous
- compelling
- bold
- broad and integrating

Grand Challenges: the end result of a series of sequential and concurrent ONR efforts, increasingly focused, each building on previous work. Intermediate Naval products are also generated (arrows).



Grand Challenges

Good/Excellent Examples

- Put a man on the moon by the end of the decade...
- Be Number One in our industry.
- Make our rivers again safe to fish in.

Bad/Poor Examples

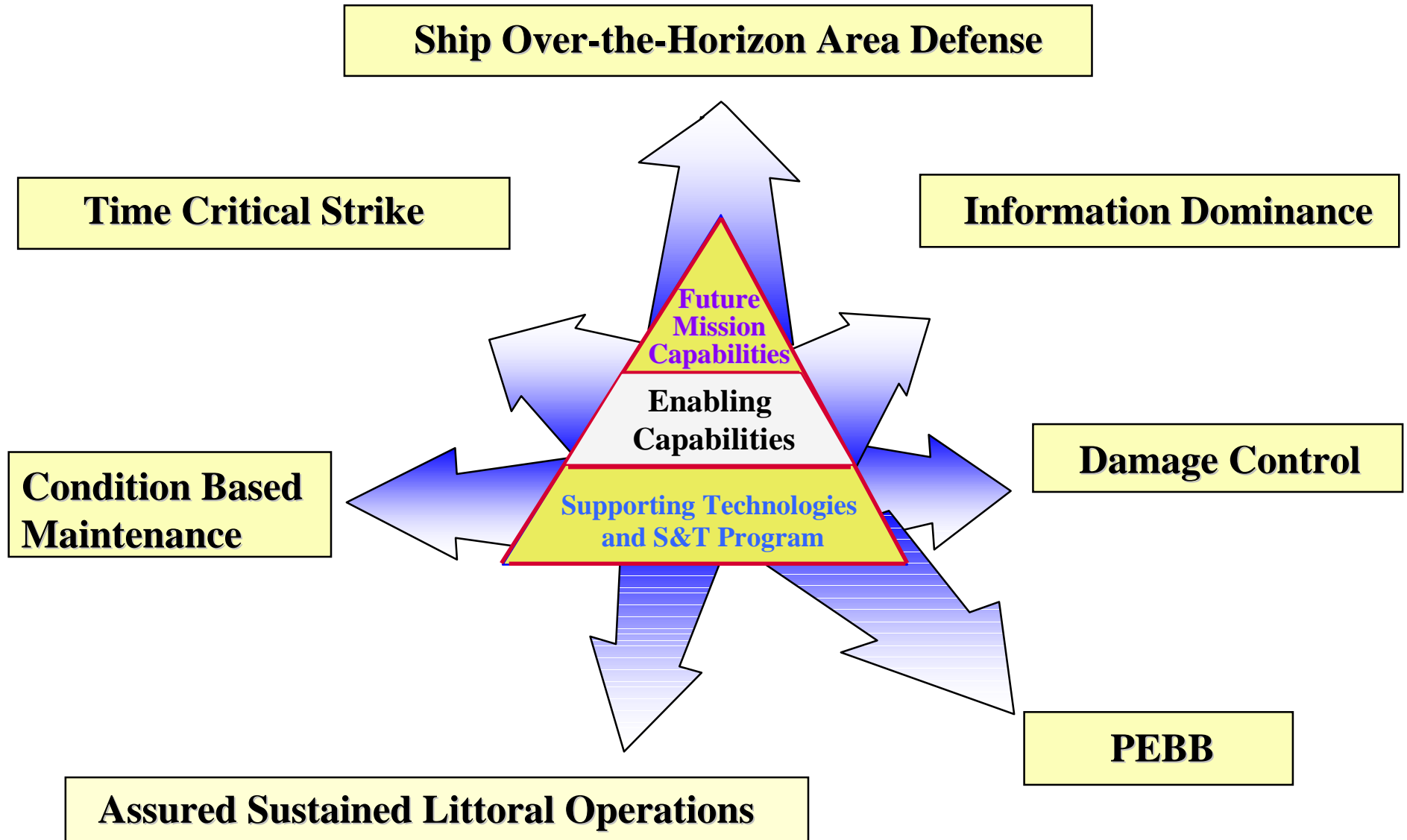
- Go boldly where no man has gone before.
- To understand the ocean.
- To make the oceans transparent.
- To predict climate.

ONR Oceanography Grand Challenges

Environmental Dominance

- Provide Maritime Intelligence, Surveillance & Reconnaissance (ISR) on Demand
- Environmentally Adaptive Sonar Systems; cost effective, self optimized
- Owning the Environment; Knowledge of the current& future environment, including effects on systems and tactics
- Subsea Littoral Adaptive Presence that can be monitored & controlled remotely from Web-like site (networked autonomous systems)
- Expanded Engagement Envelope: a.k.a. Torpedo Shield; submarine detection & classification distances that are twice the range of torpedoes
- Assured Unimpeded Movement from Sea to Shore; amphibious assaults at full operational tempo in all environments

Future Naval S&T Investment



Assured Sustained Littoral Operations

1. Mine Countermeasures
2. Littoral Information Superiority
3. Project and Sustain Forces Ashore
4. **Environmental Dominance**

A superior ability to forecast weapons, surveillance and assault systems' performance can provide "windows" of large relative advantage for the tactical decision maker. This ownership of the battlespace environment will enhance operational strengths while mitigating weaknesses. The key is a real-time forecast that resolves tactically important scales in the battlespace and that assimilates/fuses *in situ* and remote sensed data. Improved capability could lead to techniques that shape or control certain aspects of the operational systems' environment for tactical advantage (e.g. locally controlled wave motions or aerosol distributions).

Supporting Technologies

- Real-time 3D littoral environment nowcast & forecast
- Stochastic acoustic field characterization (biota, internal waves, finestructure...) to design & operate coastal sonars
- Spaceborne & airborne systems to measure & infer surface and subsurface parameters (e.g. water clarity, surface waves, stratification, bathymetry).
- MPP Computational Fluid Dynamics algorithms
- High bandwidth data communications
- *In situ* autonomous sensing system
- Databases & management of large, archives
- Data fusion algorithms

10 db Operational Capability Improvements

Assured Sustained Littoral Operations

Environmental Dominance

●●● Real-time 3D Littoral Environment Nowcast & Forecast ●●●

Operational Capability Gap

- Littoral environment nowcasts & forecasts are inadequate for system design, realistic training, doctrine development & tactical decisions
- Current observations & predictive models do not account for the high temporal & spatial variability of the littoral environment.

Capability Specification

- Continuous shipboard weather nowcast & forecast throughout the littoral battlespace for tactically relevant scales; forecast accurate TDAs & ETDA's for two days.

Key Technologies

- Coastal synoptic observation systems
- Accurate regional forecasts & nowcasts
- Data compression
- Powerful shipboard computers & displays
- Data assimilation theory & algorithms
- Forecast models for open ocean & surfzone waves

Related National/International Programs

- | <u>Program</u> | <u>Agency</u> |
|---|---------------|
| • Weather forecasting - US Coast
Observational (<i>in situ</i>) systems/networks | NOAA |
| • Coastal geomorphology | USGS & MMS |
| • Coastal physical oceanography | NSF |

Current Naval Program

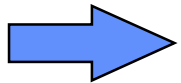
- | | <u>6.1</u> | <u>6.2</u> | <u>6.3</u> |
|--------------------------|------------|------------|------------|
| • Coastal dynamics | ✓ | | |
| • Open ocean waves | ✓ | | |
| • Coastal meteorology | ✓ | | |
| • Ocean prediction | ✓ | ✓ | |
| • Atmospheric prediction | ✓ | ✓ | |
| • Computers | ✓ | | |
| • Sensors | ✓ | ✓ | |

Technology Gaps/Opportunities

- | | |
|--|--|
| • Organic sensing systems: RPV, UUV, radar, sonar, expendables | • Re-direct & mediate local environment (e.g. visibility, surface waves) |
| • Local terrain & land surface databases | • Shipboard MPP computers |
| • Forecast model for shoaling waves (outside surfzone) | • Remote sensing (radar, sonar, satellite) & signal processing |

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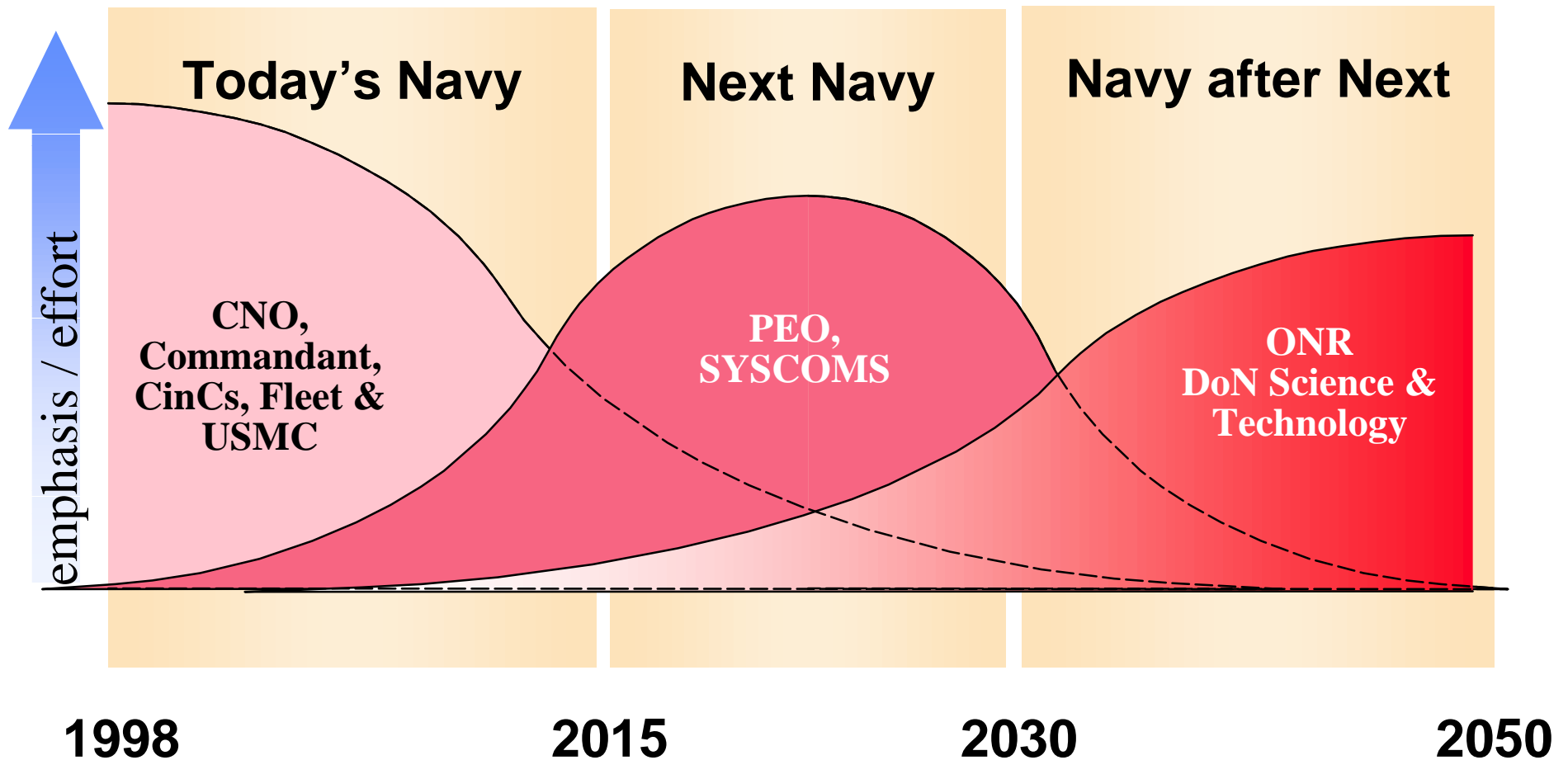


Summary

ONR Enables DoN to Capitalize on
Technology Knowledge for the
“Navy after Next”

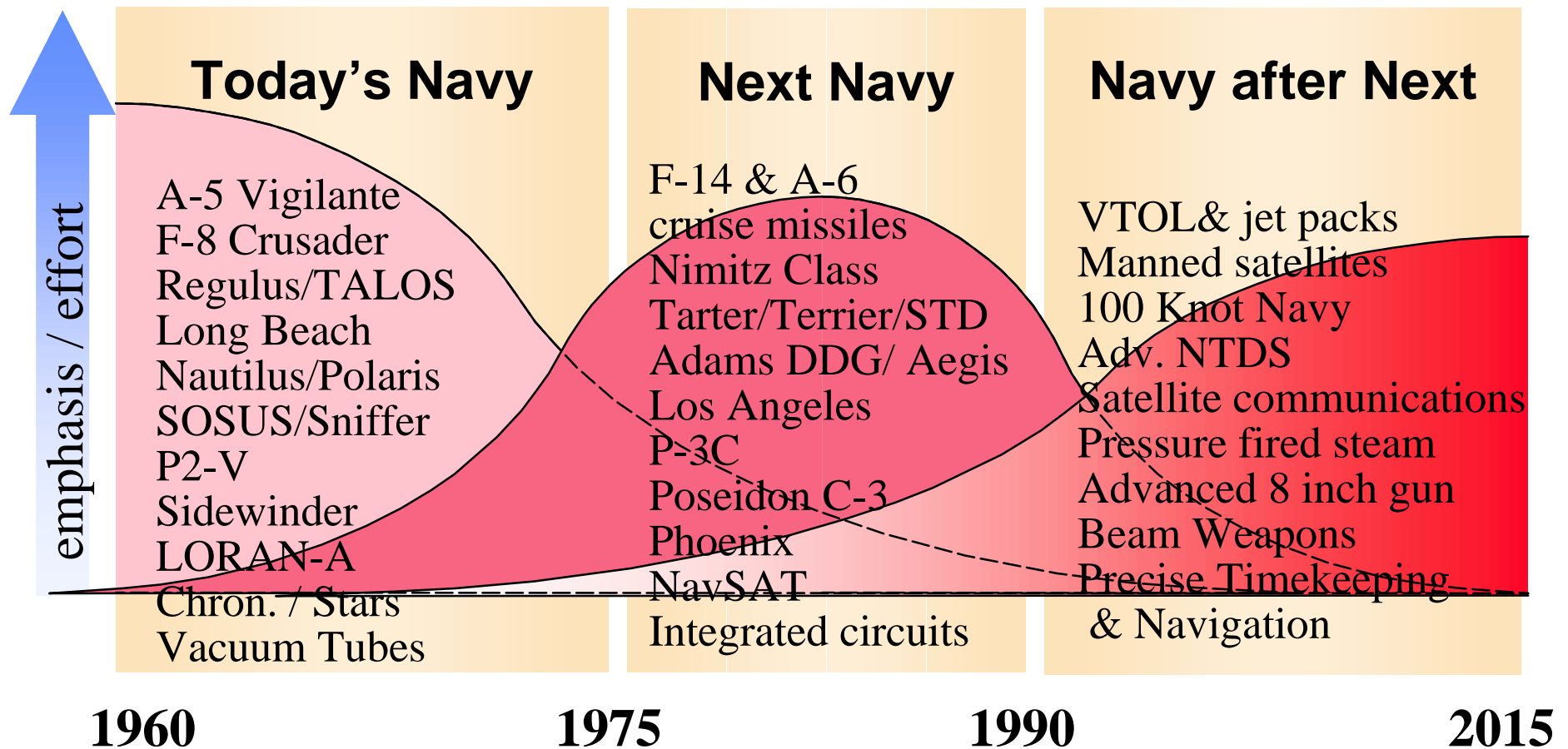
What ONR Does

Technology Perspectives



1960 Technology Perspectives

SECNAV, CNO & CMC





...the continuing dialogue



*Success depends on
continuing dialog and
redefinition of the
problem.*

Those who
know
what's
needed...

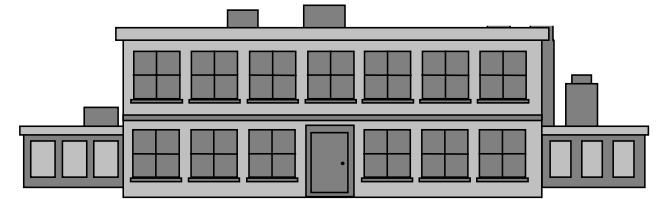
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Academia

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